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SOUTH SIERRA SHARED SERVICE AREA

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From: State and Private Forestry, Forest Health Protection, South Sierra Shared Service Area

Subject: **Potential *Leptographium* vector**.

Background.

Forest Health Protection's (A. Hawkins, M. MacKenzie, A. Hawkins) and CalFire's (Chris Lee), pathologists from different regional service areas, along with Leif Mortensen and Jackson Audley from research went to investigate the possible presence of *Armillaria* in some research plots on the Eldorado National Forest (Forest Road 10N83) on Friday, November 18, 2022. The group initially thought they were looking at badly faded Black Stain Root Disease (BSRD) of *Pinus ponderosa*. However, they failed to observe symptoms of the black staining and extensive resinosis typical in cases of BSRD. Upon returning to his lab, MacKenzie (South Sierra Service Area pathologist), decided that the images taken represented, not a pathogen, but a bark beetle vectored blue stain fungus. Nevertheless he tried to isolate a *Leptographium* from the blue stained wood, using cycloheximide amended 3% malt agar. In due course, a *Leptographium* fungus was recovered (images 4 & 5) from the blue stained wood. There exists a spectrum of *Leptographium* fungi from the purely saprophytic stain fungi to the highly respected pathogens such as the varieties of *L. wageneri* (Jacobs & Wingfield, 2001). Unfortunately, this pathologist cannot definitively separate the various members of this spectrum using only a light microscope.

Potential Vectors of *Leptographium* pathogens

FIDL #145, on Black Stain Root Disease (BSRD) has its focus on the Douglas fir variety of the causal fungus (*Leptographium wageneri* var *pseudotsugae)* Hessburg *et al* (1995). These authors make, the often-quoted statement that, "The root feeding bark beetles *Hylastes macer* and *H. nigrinus* are believed to be the primary vectors of the fungus to ponderosa pine and Douglas-fir." MacKenzie had previously recovered 12 specimens of the Red Turpentine (RTB, *Dendroctonus valens*) from the roots of a *Leptographium* inoculated *Pinus monophyla* tree. From 11 out of the 12 of the beetles, he recovered a *Leptographium* species. Since that time, isolates from this stand have been shown by DNA technology, to be the *Leptographium wageneri* var *wageneri*, the causal variety of BSRD of Pinyon pine (Daram Choi, personal communication). Goheen (1976) was one of the first to suggest *D. valens* might be a vector of BSRD. However, by 2005, in one of the earlier papers using real-time PCR to provide taxonomic information on vectoring Schweigkofler *et al* (2005) suggested that *D. valens* was unlikely to vector the *ponderosum* variety of the fungus.

Image 1. View of the mortality pocket from a distance.

RTB pitch tubes were frequently observed on the tree bases.

Image 3. Evidence of blue stain fungi,
usually assumed to have been vectored by bark beetles.

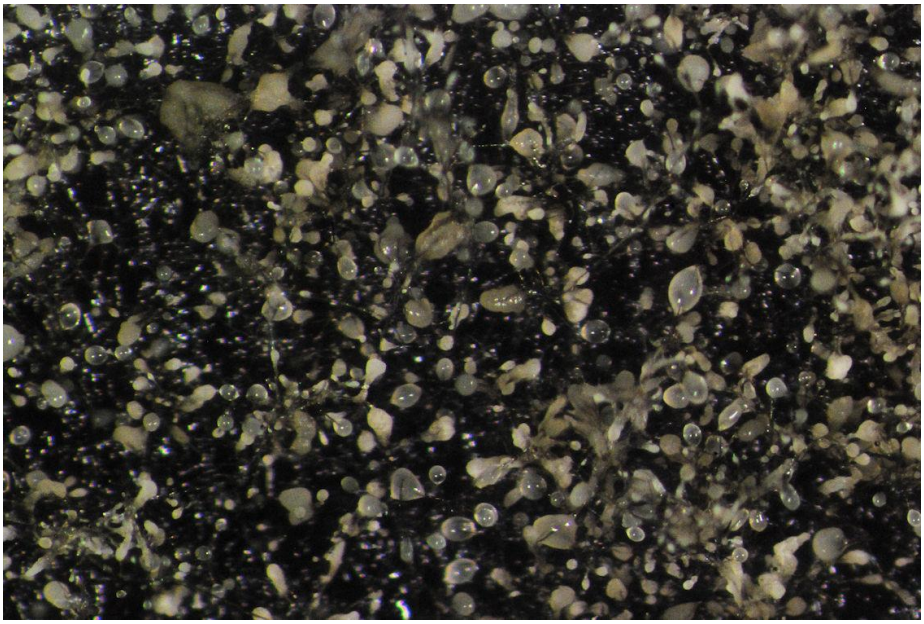

Image 4. Dissecting scope view of a plate which turned black. The clear globules are masses of sporogenous cells at the top of the *Leptographium* conidiophore.

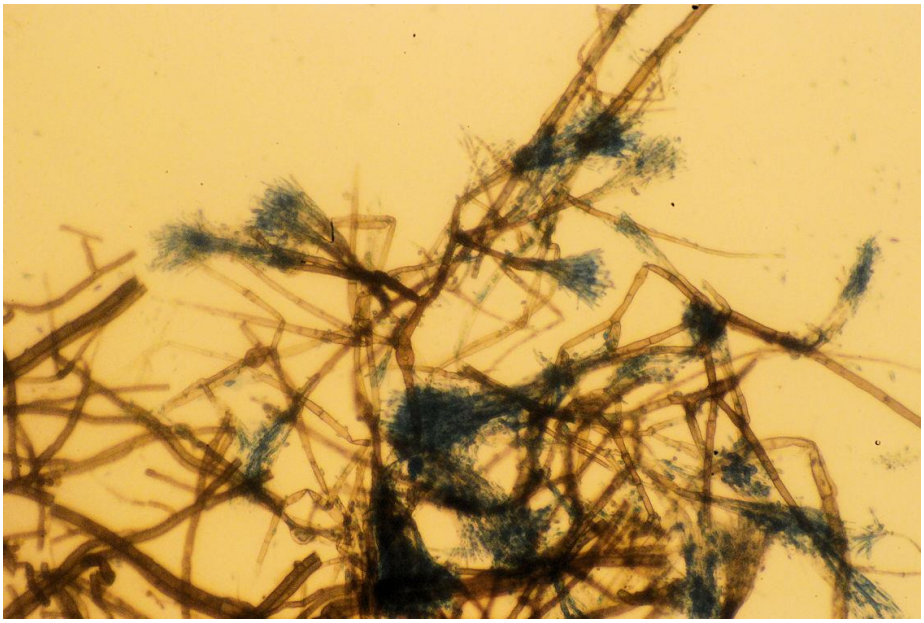

Image 5. Microscope view of the Leptographia heads

While the fungus (image 5) looks similar to the BSRD fungus, the tree did not die from BSRD. However, it is possible that the blue stain is a complex of fungi that includes a small component of an, as yet, undescribed member of the *Leptographium* spectrum.

Discussion

In the field, the pathology team suggested two scenarios for the involvement of RTB in the mortality pockets. Scenario One, RTB attacks an individual tree and weakening it to be subsequently attacked by the Western Pine Beetle (WPB *Dendroctonus brevicomis*). Under this scenario the "*Leptographium* + RTB" is seen as the inciting agent for WPB attacks.

On the other hand, (Scenario 2) WPB detects a drought stressed tree and after mass attack, the tree becomes attractive to RTB. In scenario two the WPB is the inciting agent. RTB vectors in *Leptographium* fungi. Under this scenario, the RTB is seen as being a contributory agent inadvertently being responsible for the spread of *Leptographium fungi*.

Conclusions

While these observations suggest two scenarios, it is possible that the actual situation differs from mortality center to mortality center, and the final picture could be a mixture of both. Thus, the fungal species and or variety an individual bark beetle is vectoring may depend upon the fungal community of the host species in which it pupated. Based upon these observations MacKenzie would suggest that the Red Turpentine Beetle (RTB), *Dendroctonus valens* picks up any fungus it serendipitously encounters in its local environment. In this case, RTB may have picked up a *Leptographium*, and left it as a minor component of the blue stain complex. The presence of the *Leptographium* was only detected when a cycloheximide containing agar selected for it. Thus, RTB appears to give the impression of having a mutualistic vector relationship with that fungus.

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